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NOTES ON WALKER'S TYPES OF NORTH AMERICAN LEAFHOPPERS of the GENUS DRAECULACEPHALA together WITH A NEW SPECIES.

E. D. BALL and W. E. CHINA

The determination of species in this genus, from general descriptions under the genus **Tettigonia,** has proved very difficult. The authors as the result of several years of correspondence and the exchange of specimens and drawings have arrived at definite conclusions as to the species represented by most of Walker's descriptions and have been able to throw further light on those still in doubt. Through these findings a number of misidentifications are corrected and one species which is left without a name is described.

Tettigonia prasina Walker. Homop. B. M. p, 768 from Hudson Bay is a typical male of **D. novaeboracensis** Fh., (fig. 1), as has been recorded. The broad head with the four large black spots is quite distinct in the group.

T. angulifera Walk., p. 771, from Newfoundland proves to be a female of the other broad-headed species of the eastern United States and Canada, (fig. 2). This comes as a great surprise as all previous writers have placed this name on a large narrow-headed form which now appears to be new and is described below. **D. manitobiana** Ball will fall as a synonym of the true **angulifera.**

T. antica Walk., p. 771, from Trenton Falls, New York is represented in the British museum by a male (fig. 3). This has always been considered as a synonym of **D. mollipes** Say but as shown by the drawing of the head, it is a very large insect as large as **paludosa** described below but differing from that species in having a board flat last ventral segment and broad pygofers in the male (fig. **3b**) instead of a long tubular segment and long plates hiding the narrow pygofers, as shown in figure **4d** of Plate 7 of Ball's Rev. of the

Tettigonidae (1901). The margins of the vertex are straight or concave instead of convex as in that species. The shape of the vertex and the male genitalia indicate that it is closely related to **mollipes.** The senior author has in his collection as a variety of **mollipes** a group of large forms from the northeastern part of the United States which agree with the drawings of **antica** in every particular. This seems to be the best disposition of this form that can be made with our present information.

T. producta Walk., p. 772, described from a male from St. Johns Bluff, Florida (fig. 4) and **acuta** Walk. p. 773, described from several specimens from the same place of which a female is figured (fig. 5) seem to be male and female of the common marsh species of that region, which should be called **producta.** The long acute pale yellow head in both sexes, the tawny face with a median fuscous stripe widening below and the blue-green veins on elytra, as described, are all characteristic of this common species. The angle on the clypeus in the facial profile (fig. 4c) and the broad flat terminal ventral segment (fig. 4b) of the types are characteristic of this species and render it quite distinct from **D. portola** Ball (fig. 7c), the other large species from the same region but which is further distinguished by a black faced male.

T. minor Walk. described from a single male from "United States Doubleday", (fig. 6), has always been a puzzle and still continues as one. Its chief diagnostic character is its moderate size and black face. Most of Doubleday's material came from the Atlantic Seaboard from Philadelphia south to Florida. It probably was not from St. Johns Bluff or it would have been so labelled but might have been from some other point on the Florida coast. There is a moderate sized more or less black-faced form found along the New Jersey coast and southward that has been considered a variety of **mollipes** and often called var. **minor** Walk. The western black-faced species now known as **minerva** was formerly included but is distinct and there is no reason to believe that Doubleday had any material from the western region. If it came from Florida where black-faced species abound, other characters would have to be used to determine which it represents. It has the type of profile and male genitalia found in **producta** which would exclude **portola,** it is much larger than **bradleyi**

with the clypeus green with two dark spots—while in that species it is black. If it came from the New Jersey region it is probably a variety of **mollipes.** If it came from the Florida region it may be the black-faced variety of **producta,** in which case **minor** would have page preference and would become the species name and **producta** the variety. There should, however, be more food plant and life history studies made of the Florida forms before such a change is made as there are some indications that the back-faced forms associated with **producta** may represent a distinct species and that this may be a black-faced variety of **mollipes.**

T. 7-guttata Walk. P. 773, from St. Johns Bluff is the long headed white species with 7 or more black spots common in the Florida flat woods region and about which no question has been raised.

Draeculacephala paludosa Ball & China n. sp.

Size of **producta,** nearly, with a broader shorter heavier-lined vertex. Yellow with the disc of pronotum and elytra deep green. Length female, 10-11 mm.; male 8 mm.

Vertex similar to **mollipes** in length but much broader with the lines on the reflexed portion heavier, much shorter and broader than in **producta.** Profile of face straight with a definite angle on clypeus. Elytra extremely long but equally broad; together exceeding the width of the eyes. Last ventral segment of male tubular much longer than wide; plates long slender the tips flexible and more or less folded.

Color. Deep green. The vertex anterior third of pronotum and scutellum straw yellow. Vertex with the median and oblique lines heavy; about four, dotted and slightly curved, lines on each side the reflexed portion.

Holotype female, allotype male, and six paratypes August 28, 1897, and two paratypes August 14, 1897, all taken by E. D. Ball from rushes on the edge of a swamp at Ames, Iowa. Holotype and allotype in Ball collection, paratypes in the Iowa State Coll. collection and the British Museum. The types of this species were used for the drawings of **D. angulifera** fig. 4, plate 7 of Ball's monograph of the **Tettigonidae,** 1901, but it is probable that some of the material credited to **angulifera** in that publication does not belong to this species.

Draeculacephala **Ball and China.**

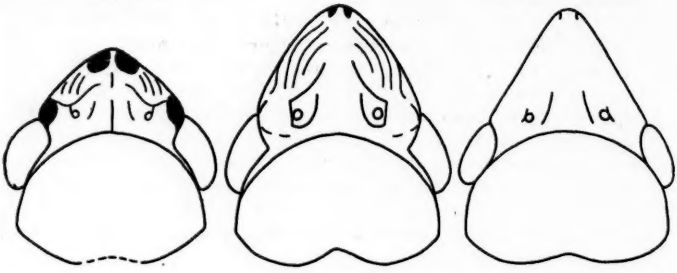

Fig. 1 D. prasina ♂ *Fig. 2. D. angulifera ♀* *Fig. 3. D. antica ♂*

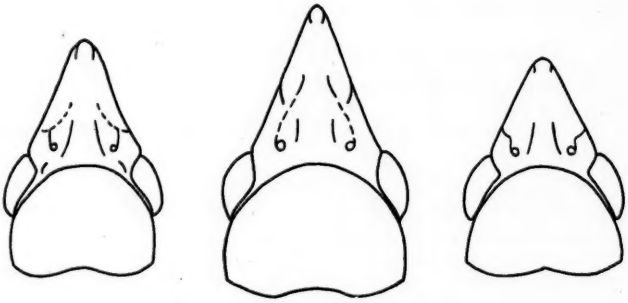

Fig. 4 D. producta ♂ *Fig. 5. D. acuta ♀* *Fig. 6. D. minor ♂*

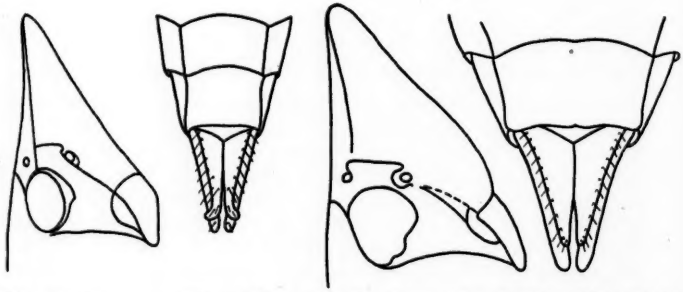

Fig. 4c ♀ *Fig. 4b ♂* *Fig. 7c D. portola Ball ♀* *Fig. 3b ♂*
D. producta *D. antica*

NEW SUBGENERA AND SPECIES OF BOMBYLIIDAE (DIPTERA)

REGINALD H. PAINTER,
Manhattan, Kansas (1)

During more than ten years the writer has collected and studied species of **Villa** in the Southwest where many undescribed and little known species exist. The **subgeneric** classification presented below is the first result of this study and is offered as a tentative solution of the problems studied. Some of the species described herewith have awaited description for a number of years. Other descriptions are necessary at this time in order to facilitate the identification and return of borrowed specimens. Specimens and types not otherwise designated were collected by the writer and are in his collection.

Genus **Villa** Lioy

The writer has recently pointed out (2) that the groups **Thyridanthrax, Chrysanthrax,** and **Hemipenthes** might better be retained as subgenera. In North America, at least, there are several species which cannot be placed in these groups as defined by Bezzi. Some of these species are intermediate in their character. Others represent small groups of species which may be defined as subgenera equivalent in rank to those named above. Two of these small groups are described below. **Dipalta** O. S., **Poecilanthrax** O. S., **Stonyx** O. S, and **Lepidanthrax** O, S. represent separate genera. **Isopenthes** O. S. is a synonym of **Hemipenthes.** The described subgenera of **Villa** may be separated as follows:

Key to Subgenera of **Villa**

1. Wings hyaline; face retreating, rounded; third antennal joint very short—conical at base; metapleural fringe dense .....Subgenus **Villa** Lioy
—Wings partly colored, when nearly hyaline; the face prominent and conically produced; the third antennal joint long—conical at base 2
2. Proboscis not projecting beyond oral margin; hypopleural pile usually present 3
—Proboscis projecting at least half the length of the oral opening beyond the epistoma; third joint of antennae

(1) Contribution No. 403, from the Department of Entomology, Kansas State College.

(2) Ann. Ent. Soc. Amer., 23:799-803.

with onion-shaped base and slender styliform portion; hypopleural pile lacking or very sparse. .....
.....Subgenus **Rhynchanthrax** new subgenus

3. Face retreating; if bluntly rounded, the front tibiae are spinose. .....Subgenus **Hemipenthes** Loew.

—Face prominent 4

4. Front tibiae spinose; face conically projecting. ....
.....Subgenus **Paravilla**.. new subgenus

—Front tibiae smooth 5

5. Face bluntly convex; wings dark at base but with hyaline spots about the crossveins and forks; third antennal joint usually short—conical. .....
.....Subgenus **Thyridanthrax** O. S.

—Face conically projecting; wings dark at base or more or less hyaline, but always darker about the veins if any color is present; third antennal joint, long—conical, tapering from base to apex. .....
.....Subgenus **Chrysanthrax** O. S.

These subgeneric divisions are relative rather than exact and it may be impossible to place certain species. The status of some of these species must remain obscure until the many little known or new species in the Southwest can be thoroughly studied. The shape of the face and of the antennae are characters in which it is impossible to make hard and fast separations. The presence or absence of front tibial spines is not even a specific character in the subgenus **Villa.** Whether or not it is in the other subgenera remains to be seen. At any rate neither of these three characters are of generic significance as they have sometimes been used.

Subgenus **Rhynchanthrax** new subgenus

Characters of **Villa** (sensu latu): face prominent but rounded as in **Thyridanthrax** (sensu strictu) sometimes slightly conical; proboscis projecting at least half the length of the oral opening beyond the epistoma; antennae with first, second and basal part of third joints subequal. The latter consists of a short onion-shaped base and a slender styliform portion longer than the remainder of the antennae taken together. Front tibiae spinose; pulvilli lacking. Hypopleura bare in male, a few small scales present in female. Tomentum entirely of dull narrow scales which are not larger at sides of abdomen as is usual in **Lepidanthrax.** Genitalia of male with a long lateral prolongation on the 9th tergite. Wings with basal part dark but with lighter areas about cross-

veins as in **Hemipenthes.** Discal cell outwardly obtuse, contact with cell Cu1 usually shorter than base of cell Cu1 but sometimes a little longer.

Subgenotype **Villa parvicornis** (Loew); included species; **rex** (Osten Sacken), **texana** Painter, **quivera** Painter and **nigrofimbriata** (Will.). **Maria** (Will.) may also belong here; **caprea** (Coq.) is similar in some respects.

The separation of this small compact group of species as a subgenus follows Osten Sacken's lead (Biologia p. 112) in dividing the large genus up into smaller subgenera for phylogenetic study and description. It is evident from a study of these groups that connectant forms exist between them and that they cannot be separated as genera. The subgenus described above shares some of its characters with the other subgenera **Thyridanthrax, Chrysanthrax, Hemipenthes,** etc., and also with the genera **Lepidanthrax** and **Stonyx.** The subgenus is more or less intermediate between the subgenera of **Villa** and the genus **Lepidanthrax. Rhynchanthrax** differs from **Stonyx** in the number of submarginal cells and in the character of the wing pattern. The former character appears to be more stable in this group than among the species of **Hemipenthes.** The species may be separated as follows:

1—Abdomen largely orange in ground color and tomentum ..... **texana** n. sp.
—Abdomen largely or wholly black, tomentum yellow 2
2—Black of of wings occupies most of anal cell; r-m crossvein surrounded by hyaline area 3
—Black of wings occupies less than half of anal cell, wings about r-m crossvein darker than near-by area ..... **quivera** n. sp.
3—Pile and tomentum of pleura largely black 4
—Pile and tomentum of pleura largely yellow or white ..... **parvicornis** Lw.
4—Base of scutellum white tomentose ..... **rex** O. S.
—Base of scutellum yellow tomentose ..... **nigrofimbriata** Will.

Villa (Rhynchanthrax) parvicornis (Lw.)

The 112 specimens studied show a variation in size from 6 to 14 mm. The black tomentum on segments three, four and often five of abdomen is a fairly constant feature but sometimes is completely lacking. There is

every gradation and no correlation with geographic distribution. Sometimes nearly as much as one-half of the anal cells lie within the hyaline area of the wing. On other specimens the black extends as far as the tip of 1st A.

Parvicornis has been reared from **Tiphia** cocoons in Illinois by Davis (1).

Texas: Brownwood, June 7, 11, 13, July 21, August 22, Sept. 17; Mills County, July 20; Victoria, August 1; Port Lavaca, August 1; Kyle, July 13; Ranger, August 18; Junction, August 15; Austin, May 30, June 26, October 30 (R. H. Painter); Galveston Is., August 9, Kingsville, July 6, Brownsville, July 23, (F. M. Hull). San Antonio (G. P. Englehardt). 10 mi. east of Lantry, July 3, (H. M. Smith).

Kansas: Riley County, July 6, 11, 14, 27 (Popenoe) (Geo. A. Dean), (Acc. 1918, 1994, 5226, 1952); July 28 (R. H. Painter). Marquette July 5; Arcola, July 26; Pottawatomie County, July 28 (on flowers of Houstonia) (R. H. Painter).

Missouri: Atherton, July 15 (C. F. Adams).

Arkansas: Miller County, July 5.

Mississippi: Oxford, June 15 (F. M. Hull).

Villa (Rhynchanthrax) texanus n. sp.

This species superficially resembles **V. cypris** (Meig.) **(fulvohirta)** but is structurally related to **V. parvicornis** (Lw.) and **rex** (O. S.).

Thorax blackish, abdomen and legs reddish, but the former with a centro-basal black spot. Pile and tomentum mostly yellow to orange; a stripe of white tomentum across base of scutellum. Wings with basal half black; tibiae spinose. Length: 5 to 9 mm.

Male—Ground color of head black; face and first two joints of antennae yellowish; of thorax and coxa black; legs reddish, abdomen reddish, a black triangle with apex directed distad, at base of abdomen, e. i., first abdominal segment and a trapezoidal area on two and three and a triangle on four black. Venter at base brownish. Antennae with first two joints and onion-shaped base of third subequal; the thin styliform prolongation of the latter nearly twice as long as the remainder of the antennae. Proboscis about twice as long as mouth cavity. Head black pilose and orange tomentose,

(1) Bul. Ill. Nat. Hist. Survey, 13, 5, 72.

occiput light yellow tomentose. Thorax yellowish white tomentose and pilose, lighter on pleurae and darker about coxae; posterior two thirds of dorsum and scutellum orange tomentose, a white tomentose band across base of scutellum; legs orange tomentose, coxae mixed orange and black tomentose; thoracic spines black. Abdomen orange tomentose and pilose, a few black hairs on the sides of segments three and four and a tuft of white ones on the sides of one. An area of black tomentum on center of black spots of segments three and four. Genitalia orange. Wings with basal half black, the line of division running from near apex of subcosta to tip of 1A; lighter areas on r-m crossvein, base of R1 and R2 plus 3, arculus, and base of cell Cu1. Contact of discal cell and Cu1 punctiform.

Female—Like male, a few scattered black hairs on abdomen, especially on venter and last segment. As a group the females tend to have larger black areas on abdomen and head. The species is quite variable in size.

Type, male, Junction, Texas, August 15, (R. H. Painter).

Allotype, female, Junction, Texas, August, 15, (R. H. Painter).

Paratypes, 4 males, 2 females same data as types; 3 males, 3 females Austin, Texas, June 7, 1921 and June 17, 1922; 2 males Mills County, Texas, July 20, 1931, (R. H. Painter); 1 male, 2 females Chisos Mts., Brewster County, Texas, July 9, 1930, (H. M. Smith); 1 male Anhalt, Texas, June 28, 1917, (R. C. Shannon): 1 female, 20 mi. west of Hope, New Mexico, August 6 (R. H. Painter; 1 male Davis Mts., Texas, July 1, 1931 (Geo. P. Englehardt); 1 male Waco, Texas, (Belfrage) in U. S. National Museum.

Types and paratypes, except the last, are in the author's collection.

Villa (Rhynchanthrax) quivera n. sp.

Similar in general appearance to **catulina** (Coq.) and **webberi** (John.) but lacking pulvilli and agreeing in structure with **texana** Painter and **parvicornis** (Lw.). Length 4 to 6 mm.

Male—Ground color dull black; legs, except coxae, about oral opening, and first two joints of antennae yellow. Yellow tomentose; a hollow square of white pile and tomentum across front of thorax, base of scutellum, and above wings; another patch below wings. Yellow

pilose except as described above and with the exception of a few black hairs on dorsum of thorax apex of scutellum, and on second and following abdominal segments. Spines of thorax yellow, of legs black. Front tibiae spinose, face somewhat more prominent than in other members of the group. Proboscis projecting about half the length of oral opening. Antennae with first, second and base of third joint subequal. The styliform prolongation a third longer than the remainder of antennae. Wings hyaline, basal third black, the outline extending in a series of steps from the tip of subcosta until it meets the posterior margin half way from the base of the anal cell. A light spot near the base of cell R1; other veins, especially r-m corssvein at base of Cu1 and R 3, margined with darker color. R2 and 3 near its end bisinuous S-shaped; R2 plus 3 originates about the length of the r-m crossvein before that crossvein. Contact of discal cell and cell Cu1 about as long as base of Cu1.

Female—Similar to male, legs tinged with black especially the posterior parts of femora and black tomentose on these areas. Venter of abdomen with a few scattered black hairs.

Holotype male, **allotype** female, 13 male, 3 female **paratypes,** Gran Quivera, New Mexico, August 10, 11, 1931, (R. H. Painter).

Subgenus **Paravilla** new subgenus

Characters of **Villa** (sensu latu). Face very prominent, much more so than in **Chrysanthrax** or **Hemipenthes;** proboscis not, or very slightly projecting from the oral cavity. Antennae with first segment longer than second; third short—conical at base, and with a styliform portion somewhat longer than the conical base, the junction between the two may or may not be sharply marked. Front tibiae spinose; pulvilli lacking. Metapleura thickly pilose in both sexes. Tomentum entirely of narrow scales which very often do not form bands of contrasting colors on the abdomen. Wings with basal part dark, never with lighter areas on the crossveins, sometimes nearly entirely hyaline. Discal cell outwardly rather obtuse, contact with Cu1 punctiform.

Subgenotype **Villa edititoides** Painter; included species **Villa consul** (O. S.), **cuniculus** (O. S.), **palliata** (Loew), **diagonalis** (Loew), **obscura** (Coq.), **lacunaris** (Coq.), **nemakogonensis** Graen., etc.

This group of species was defined but not named by Osten Sacken.*

Villa (Paravilla) edititoides n. sp.

Body black, except yellow first antennal joint, face and legs almost entirely clothed with yellow tomentum and pile, wings brown on antero-proximal portion.

Male—Ground color black; first antennal joint, sides of face, legs except coxae, and margin of last two abdominal segments yellowish. Pile and tomentum yellow, the pile black on front, face and antennae, and mixed black and yellow on front four coxae; tip of abdomen whitish pilose; bristles of body yellow, of legs black. First joint of antennae about as long as second. Wings hyaline, antero-proximal half brown, the outline curving, from apex of subcosta to near end of anal cell. The brown does not fill discal cell to r-m crossvein but encroaches on 1st M2 and Cu1.

Female—Similar to male but with a few black hairs along margins of segments near tip of abdomen.

Holotype, male and **allotype,** female, LaVeta, Colo., Sept. 2 (E. M. Painter).

Paratypes.

Colorado. LaVeta, Sept. 2, (E. M. Painter) 2 males 2 females; Huerfano County, Aug. 14, 1928, 6000 ft. elevation, 1 male, 2 females; Boone, Colo., Aug. 17, 1928, 5000 ft. elevation, 1 female; Kiowa Co., August 19, 4000 ft. elevation, 1 male; (R. H. Painter).

Utah. Dividend, Aug. 17, 20, 24, Sept. 1, 2, 17; (Tom Spalding), 3 males, 5 females.

N. Mexico. Springer, Aug. 17, 1914, (W. M. Springer) 1 male; Tajique, Aug. 13, 1931, (R. H. Painter) 1 female; 15 mi. E. Santa Fe, June 27, 1931, elevation 7100 ft., (H. A. Scullen), (in the Oregon Agricultural College Collection), 1 male.

California. 11 mi. W. Ludlow, June 22, 1931, 2150 ft. elevation, (H. A. Scullen) (in Oregon Agricultural College Collection) 1 male; Los Alamos, Aug. 1, 1930 (T. F. Winburn, R. H. Painter) 1 male.

Oregon. Klamath Falls, June 24, 1 male.

Texas. San Antonio, 1 male, Austin, April 30, 1921; May 5, 1924, 2 males, 1 female. Brownwood, June 7, 10, Sept. 15, 1920, 8 males, 1 female; Sweetwater

* Biologia Centrali Americana Dept. 1:127.

Sept. 14, 1921, 1 male (R. H. Painter).

Kansas. Manhattan, May 6, 1932, June 8, 1931, May 25, 1932, June 6, 1932. (R. H. Painter), 8 males, 5 females.

In the series there is some variation in minor points. The ground color of the abdomen is almost completely black in the female while in the male the last three segments are more or less reddish. The face is entirely red in some specimens, in others the black stripe extends from the front, between the antennae and almost or quite to the tip of the epistoma. Most specimens lack the black pile on the abdomen, in others it is always scarce and limited to the centers of the segments, being most abundant on the fifth. The amount of white pile on the last abdominal segment is variable. The second antennal joint is frequently brownish but always much lighter than the third. The length of the proboscis is variable within narrow limits. In most specimens the wing pattern is as described, in others it is more or less extended into the cell 1st M2, R1, and may fill the discal cell almost to the r-m crossvein.

As defined above **edititoides** includes a part of those forms included by Coquillett* under **edititia** Coq. nec Say. It is impossible to be certain whether **A. vestita** Walk. is this species without an examination of the type.

V. diagonalis Loew differs from **edititoides** especially in the totally black face and antennae; **palliata** Loew by the bright, reddish pile and darker ground color; **obscura** by the gray hyaline wings with the veins at the base and many crossveins margined by brown.

At Manhattan, Kansas, this species is parasitic on a solitary bee which nests in the ground. Two specimens were reared from the pupae and a number of additional pupal cases collected. A mating pair was seen May 26, the first adult three days earlier. During the early part of June the females were seen flying over the openings to the nests of solitary bees and flipping eggs into the openings. In order to collect the eggs, a dozen shell vials with the same sized opening as the nests were buried among the nests. During a single day fifty eggs were collected in the vials. The eggs are translucent, white, oval and evidently covered by a sticky material as they become covered with sand very quickly. One of average

* Trans. Amer. Ent. Soc., 14:175.

size measured was 0.5304 mm. in length and 0.2754 mm. in greatest width. *

Villa (Paravilla) spaldingi n. sp.

Male—Female, near **extremitis** (Coq.) but the black of the wings more extensive, and the vesture of the abdomen different. Wings half black, body black, as is much of the pile and tomentum; dorsal parts of thorax and base of abdomen orange yellow pilose, last segments in male white tomentose and pilose.

Male—Ground color back, black pilose and tomentose except as noted. Face, front, and occiput orange tomentose; third joint of antennae elongate conical. Pile of dorsum of thorax including tuft in front of and behind wings orange yellow; quite sparse on the disk and scutellum; bristles above wings orange, the rest black. Orange yellow pile on sides of first, second and part of third segments; sometimes extending across the dorsum on first segment. Sixth and seventh segments white pilose and tomentose above and white tomentose beneath. Wings with antero-proximal three-fifths black, the margin extending almost straight from near tip of subcosta to tip of anal cell and including more than half the discal; color almost uniform.

Female—Similar to male but lacking the white tip to the abdomen. The center of segment seven is conspicuously yellowish tomentose.

Type, male, Dividend, Utah, September 1 (Tom Spalding).

Allotype, female, Dividend, Utah, August 29, (Tom Spalding).

Four **Paratype** males, Dividend, Utah, August 17, September 7, (Tom Spalding).

Type, allotype and four paratypes in author's collection. One paratype male, Dividend, Utah, Aug. 4, (Tom Spalding) and one male, Bryce Canyon (V. M. Tanner) in collection of Brigham Young University.

Villa (Paravilla) xanthina n. sp.

A densely orange pilose and tomentose species with nearly hyaline wings; face yellow, pile of coxae yellow.

Male—Ground color black; face, first two antennal joints, tibiae and distal part of femora yellow. Densely yellow pilose and tomentose. No black pile except on

* There is a picture of the eggs of this species in Lingnan Science Journal 11 : 342.

basal joints of antennae and base of costa where it is mixed with yellow. Narrow stripes of black tomentum on apices of abdominal segments two, three, four and five; segments six and seven densely white tomentose. Spines of body yellow, of legs black. Wings hyaline, basad of arculus, subcosta and clouds on r-m crossvein, and about veins surrounding cells R and M yellow or brownish. The clouds are not conspicuous except in certain lights. In some specimens the anal and axillary cells are smoky.

Female—Similar to male but lacking white tomentum and with the black tomentum less conspicuous.

Holotype, male and **allotype** female, Seward County, Kansas, June 29, 1929 (E. M. and R. H. Painter, collectors) along Cimmaron River.

Paratypes, Texas. Thirty-eight specimens from Brownwood, June, July and August; Austin, May 30, 1921, June 26, 1921; Erath County, June 6, 1929; Mills County, July 20, 1931; Kingsville, June 7, July 8, 1921 (F. M. Hull); Pecos, June 16, 1929, (E. M. and R. H. Painter).

Oklahoma. Lawton, June 3, 1930, (R. H. Painter).

Kansas. Morton County, June (F. H. Snow), (in C. W. Johnson Collection).

The general color of pile and tomentum is sometimes yellow rather than orange and on some specimens the pile on the face is black rather than yellow. In a few cases the center of the face is dull black. This species is similar to **adumbrata** Coq. in general appearance but not in structure.

Villa (Paravilla) nigronasica n. sp.

A densely orange pilose species with hyaline wings; protruding black face and pile of coxae black; superficially resembling **V. fulviana** (Say).

Male—Ground color black, oral margin and knees sometimes yellowish. Antennae, front and face black pilose; face and front sparsely orange tomentose, occiput yellow tomentose. Thorax and abdomen orange pilose and tomentose, the center of segments two, three, four and five sparsely black tomentose, segments six and seven white pilose and tomentose; thoracic spines orange; legs orange tomentose, fore and middle coxae and femora black pilose, some black pile mixed with the yellow on hind coxae; spines black. Wings hyaline, subcosta and basad of arculus yellow.

Female—Similar to male but lacking the white

tomentose apex of abdomen. Tomentum somewhat denser but not as dense as in **xanthina.**

Holotype male, Halsey, Nebraska, August 12, 1925 (R. W. Dawson). **Allotype** female, Halsey, Nebraska, August 11, 1925 (R. W. Dawson), (in Minnesota University Collection).

Paratypes, 8 males and 1 female Halsey, Nebraska, August 11, 12, 13, 16, 31, 1925 (R. W. Dawson), (in collection of University of Minnesota); 1 female Morrison, Colorado, July 10, 1899, (in collection of C. W. Johnson); 1 female, Dividend, Utah, Sept. 1 (Tom Spalding); 1 male, 3 females, Medora, Reno County, Kansas, September 22, 1923 (R. H. Painter); 1 female, Kiowa County, Colorado, August 19, 4000 ft. elevation (R. H. Painter), (in the author's collection).

This species is quite close to **xanthina** but differs from that species in the more prominent, black pilose, black face, black antennae, more hyaline wings, black pilose coxae, and less tomentose body. Typically it seems to be a sand dune species.

Villa (Hemipenthes) wilcoxi. n. sp.

Male entirely black and black haired; female similar but with some pile and tomentum of thorax and basal abdominal segment orange yellow. Wings half black, pulvilli present. Length 7.5 to 10 mm.

Male—Entirely black, black pilose, a few yellowish scales on the face and front but none elsewhere. The tomentum of the abdomen is very sparse and hair like. Face somewhat more prominent than in **morio,** and with a deeper genal groove. Antennae with the third joint elongate conical rather than short conical as in **morio.** Front tibiae with small spinules, front tarsi reduced. Wings very similar in pattern to **morio** but the black in the discal cell reaches the r-m crossvein only as a border to the radial vein. The cross- and transverse veins bordered with subhyaline but not as conspicuously so as in **morio,** R5 widely open. Length 10 mm.

Female—Similar to male but with more yellow scales on the head. Dorsal margins of thorax, first abdominal segment and anterior half of lateral margins of second segment orange yellow pilose. Dorsum of thorax and scutellum orange yellow tomentose. Fringe of alulae of yellow scales. Length 10 mm.

Type male, **allotype** female and one male and one female **paratype.** Mt. Rainier, Wash., Sunrise, 6380 ft.,

Aug. 13, 1931 (J. Wilcox). The species is named in honor of the collector.

Bombylius albicapillus var. **diegoensis** n. var.

Very similar to **albicapillus** Loew, but differs in the possession of black pilose stripes on the thorax, a fan-shaped tuft of black pile in front of the halteres and at other places over the body. Length 11 mm.

Male—Structure and vesture of the head similar to **albicapillus**.. Thorax as in **albicapillus** but the lighter pile on the front part of thorax is denser and divided in the center by a conspicuous stripe of black pile with an additional black stripe on each side of this further back on the thorax. The central stripe stops short but the lateral ones merge with the darker hairs on the posterior part of the thorax. The fan-shaped tuft of pile in front of the halteres which is white in **albicapillus** is black in this form. The abdomen as in **albicapillus** but not furnished with the appressed tomentum typical of that species, possessing a few more black pile on the dorsum and many more on the venter. Venter of abdomen with a central tomentose, appressed, white stripe. Legs and wings a little darker than in **albicapillus.**

Female—Similar to male. Central stripe extending back on to the center of the thorax, pre-halteral tuft sometimes brownish or partly white, lateral thoracic stripes sometimes evanescent. In both sexes the general body pile as in **albicapillus** varies from whitish to dark yellow.

Holotype male, **allotype** female, (in author's collection). 20 males, 11 females, **paratypes,** San Diego, Calif., March 27, 1915, (W. S. Wright), 2 males, Griffith Park, L. A. County, Calif., March 21, 1915; and 1 female, Millard Canyon, L. A. County, Calif., May 3, 1915, (from C. F. Adams, collection); 1 female San Diego County, Calif., July 4, 1929, (P. W. Oman) (University of Kansas collection).

I am indebted to the late Dr. C. W. Johnson for comparing typical specimens of **albicapillus** with the type in the museum of Comparative Zoology.

Bombylius austini n. sp.

Pile white or grayish with black pile on second and third segments, oral pile white, legs yellow, basal third of wings brown, the margin very distinct. Length 8 to 10 mm.

Male—Black, face brown, protruding. Pile and tomentum white, sometimes with grayish cast. Pile black on antennae, front, ocelli, and a few on posterior margins of scutellum, second and following segments, and tufts on the sides of second and third segments; venter white pilose. Pile brown on a stripe from the lower posterior edge of eyes to scutellum except near base of wing. An inconspicuous stripe of white tomentum in center of abdomen. Legs yellow, white pilose and tomentose, spines black, coxae sometimes with yellow hairs; wings brown on basal third, the remainder hyaline, the margin of brown runs from tip of R1 to axillary incision with the edge quite distinct. Length 10 mm., proboscis 6 mm.

Female—Similar to male, the brown thoracic stripe not distinct. Abdomen white tomentose, front white tomentose, brown and white pilose.

Type, male, Austin, Texas, April 18, 1923; **allotype,** female, Austin, Texas, April 23, 1921, (R. H. Painter).

Paratypes, 9 males, Austin, Texas, April 10, 18, 23, May 2, (R. H. Painter).

Some of the specimens were collected on flowers of **Tetraneuris linearis** (Nutt.). The female is badly rubbed. This species differs from **B. ravus** Lw. in the brown wing pattern, from **B. lancifer** in the white oral pile and from **B. incanus** in the more protruding face, black antennal pile and brown thoracic stripe.

Bombylius texanus n. sp.

The largest known North American **Bombylius.** Proboscis about as long as the body, which is almost wholly orange yellow; wings infuscated on basal third, the brown evanescent toward tip and posterior margin. Length 12 to 15 mm.

Male—Ground color black, face brownish, grayish pollinose; face, front and antennae black pilose, occiput yellow pilose, beneath head white pilose. First antennal joint approximately 0.4 mm., second 0.2 mm., third 1.2 mm. Thorax yellow pilose, a small tuft of black hair in front of wings, below which the hair is whitish; suprasquamal tuft white; bristles yellow. Abdomen yellow pilose and sparsely yellow tomentose, a few scattered black hairs on dorsum and venter, a tuft on sides at posterior angles of segments two and three and about

genitalia; inconspicuous patches of white tomentum in center of segment two and on sides of segments three, four, and five. Legs brown, blackish at base and apex of femora; yellow pilose, a few black hairs among the yellow on coxae; spines black. Wings with antero-basal third brownish, the color evanescent posteriorly and apically, disappearing last near the veins. Length 12mm., proboscis 9 mm.

Female—Similar to male but the pile more of an orange yellow and lacking all the black pile on thorax, and all on the dorsum and sides of the abdomen; fewer black hairs on the venter except on the last segment. Tomentum of abdomen dense, yellow but with smaller patches of white in the same place as in the male. Sometimes a whitish stripe down center of abdomen. Front sparse orange yellow pilose. Sides of thoracic dorsum sometimes whitish.

Type male, Brownwood, Texas, June 7, 1929; **allotype** female, Brownwood, Texas, June 7, 1929 (at flowers of **Monarda**) (R. H. Painter).

Paratypes 1 male, 35 females, Brownwood, Texas, June 7, 12, 13, 1929 (at flowers of **Monarda**); 3 females, Erath County, Texas, June 6, 1929; 2 females, Austin, Texas, May 21, 1921 (at **Monarda**) and 1 male, Austin, Texas, May 24, 1922, (R. H. Painter); 1 male, 2 females, Eastland County, Texas, June 3, 1921, (Grace C. Wiley) (in Minnesota University collection).

This species may be similar to **helvus** Wied. but the description of that species is too short for certainty. It is moreover much larger and quite different from **B. varius** Fabr. to which Wiedmann compares **helvus.**

THE ENTRANCE OF CODLING MOTH LARVAE INTO FRUIT, WITH SPECIAL REFERENCE TO THE INGESTION OF POISON.

PAUL M. GILMER, Associate Entomologist,
Bureau of Entomology

To a very large extent the control of the codling moth has been dependent upon the use of stomach poisons against the newly hatched larvae. While reasonably satisfactory control is generally obtained under field conditions, nevertheless a considerable percentage of the young larvae successfully enter fruit even at points well protected by deposits of the arsenical. This is probably due to the known larval habit of rejecting the first bits after having bitten them out, and in this manner rejecting, to a large extent, the poisoned portion.

Since this is the usual custom the question arises as to the manner in which the larva obtains a lethal dose of poison. This paper endeavors to shed some light upon this question from the standpoint of a study of the entrance habits of the young larva, and an examination of the larval body contents a short time after it has entered.

Owing to the fact that extensive experiments in the incubation of eggs of the codling moth were being carried on, a plentiful supply of newly hatched larvae were available for observation. The methods pursued included first, a careful study under moderately high magnification of the habits of the larva in entering fruit; second, spraying the fruit with some appropriately colored matter so as to permit a study of the contents of the larval body, and also a study of the mechanical role played by the setae, legs, and other larval appendages in carrying foreign materials into the pulp of the fruit.

The usual conduct of the entering larva is somewhat as follows: After a period of more or less aimless wandering over the surface of the fruit, and a testing of various spots with the maxillae, the larva finally decides upon some particular spot. The first action denoting intention to enter is a rapid back-and-forth "wagging" motion of the anterior end of the larva. Although no silk could be seen, there is little doubt from subsequent observations that the larva is actually spinning a net of silk for the attachment of the thoracic legs.

Following this weaving movement the larva sets to work upon the skin of the fruit. The head is somewhat reflexed beneath the thorax as the larva endeavors to force the point of the mandible through the tough outer skin. This part of the labor takes from four to as much as fifteen or twenty minutes, usually averaging about six minutes before the skin is finally pierced. A small crescent of skin is then quickly cut and cast aside. Very rapidly other such bits are cut out and discarded in like manner. These bits are loosely thrown aside but evidently stick to the silk weaving since, even though the worm is in such a position as to permit the bits to fall freely, but very few of them do so; rather they cling to the skin about the entrance.

It is during this process that poison would most likely be taken into the mouth of the larva, hence the exact manner of the cutting out of these bits of skin is of importance. The cutting is done not by merely shearing out the bit of skin with the tip of the mandible, but the skin is actually taken into the mouth as it is cut, and when discarded is apparently removed from the mouth by the raising of the gular sclerites until it is forced out sufficiently to be seized by the maxillae, with which it is passed through the opened mandibles and dropped. The whole process is a ridiculous reminder of a cow regurgitating her cud, except that the expulsive effort is so rapid that it is with difficulty that the details can be seen, especially as the head of the larva must be turned to the side in order to see just what is occurring. Just previous to disgorgement the gular section is seen distended into a pouch. The mandibles open as the head is turned aside, the gular sclerites are raised, and the bit is rapidly pushed out by the maxillae, the whole process taking but a fraction of a second to accomplish.

Once it was determined that the bits of skin were actually taken into the mouth, the next questions were, whether the larva actually retained any arsenical within the buccal cavity after disgorging the bit of fruit, and whether additional poison was introduced into the pulp by the larva after piercing the skin.

To determine this, recourse was had to fruit sprayed with dye. The first dye used was alizarin, which is insoluble in water and harmless. Unfortunately the brownish color of the dye almost coincided with the color of the oxidized fruit pulp, and also differed so little from

the brown of the head capsule as to be indistinguishable.

The next dye tried was carmine, a dye rather insoluble in water and giving a bright clear red to make contrast. This was sprayed upon the fruit using a small spray gun with attached blower. The fruit was given a coating comparable to fruit sprayed with lead arsenate at 2 pounds to 50 gallons, and was permitted to dry. The calyces and stem ends of the sprayed fruit were then filled with hard paraffin to discourage entrance at these points and the larva placed upon the fruit for observation.

The spray material seemed not to inconvenience the larvae in the least, and they readily made entrance through it. The larvae, while wandering about the fruit, picked up considerable quantities of the dye-stuff on the setae, maxillae, and other appendages.

After cutting the first hole through the skin, it was noted that the larva continued to reject bits of apple even after it was well into the pulp. These bits were piled about the entrance, and, as the larva began to bury its anterior end in the fruit, were frequently pulled into the hole again as the larva pushed itself in and out in depositing fresh bits outside the cavity. From time to time as the fallen bits began to be troublesome, the larva paused in digging, backed out of the hole, and rapidly spun fine threads of silk over the piled-up bits of fruit. After this procedure the bits were held fairly firmly until a fresh accumulation of untied bits again began to be dragged into the cavity, necessitating another pause for spinning. The small bits were rolled over the skin of the fruit by the larva's vigorous movements, rapidly becoming coated with the carmine. These when dragged into the cavity carried the carmine with them and upon removal frequently left small bits of the dye within the cavity itself. This staining was confined largely to the upper portions of the cavity, the deeper parts being protected from the falling bits by the head of the larva. Bits of dye on the setae were also frequently wiped off upon the sides of the cavity as the larva buried itself deeper, so it is evident that a considerable quantity of such foreign materials is carried under the skin by the larva in entering.

Since the larva continues to reject the fruit, even after it has completely buried itself within the apple, it is questionable as to how much of the poison so taken in

is subsequently ingested by the larva.

The larva upon finally entering the fruit continues for some time either to back out, or sometimes to turn completely about within the cavity to carry the bits of fruit outside. Finally it spins webbing over the entrance hole but for some time at least continues to bring the bits of fruit back and attach them to this webbing. Occasionally the whole accumulation will be pushed out. Although at this stage the movements of the larva are so masked by the frass as to be impossible to follow accurately, there is little doubt but that after this pushing out of the accumulation it again spins webbing and continues as before. Probably this process continues for some hours, possibly for a full day or more, before the larva actually begins to eat the bits of fruit as removed. It is not improbable that the larva actually penetrates to the seed cavity before it begins to consume the 'pulp', since the frass about the entrance hole for a day or two shows the light tan color of the oxidized pulp rather than the dark coffee color of intestinal ejecta. Larvae removed from the fruit 24 hours after entering show the presence of little or no solid matter in the fore portion of the digestive tract. It is of course probable that considerable quantities of juice may be swallowed, and the slight discoloration of the larva, a faint brownish tint, may be due to this. The apparently empty condition of the tract just behind the head would indicate that no solid food had been taken.

A number of heads were removed from larvae after they had half entered fruit. These heads were teased apart with fine needles and crushed under cover glasses for examination. In order to prevent contamination from bits of dye attached to the setae, etc., the larvae were immobilized by crushing the posterior end on a slide. The head was then carefully detached from the body by placing a needle point behind the capsule and dragging it forward and free of the thorax. This usually pulled a considerable portion of the fore end of the alimentary tract out with it, permitting an examination of this as well as the head. The head was then removed to a clean slide, the needles cleaned, and the head teased apart and crushed. This procedure exposed the buccal cavity, mandibles, etc., reasonably clearly. Practically all the larvae examined showed traces of considerable carmine dye. The mandibles generally showed no more

than tiny dots of crimson, but the floor of the buccal cavity was often deeply colored by the dye stuff. It was more difficult to demonstrate dye in the roof of the mouth cavity since the deep brown color of the chitin failed to transmit light well, and masked the red of the dye to a considerable extent. However, in some cases the carmine could be seen in the roof of the mouth cavity.

The exact location of this material in life could not be shown. The teasing probably tended to smear it pretty well over the whole of the cavity, and some of it may well have originated in dye attached to the maxillae. Since however, a sufficient time was permitted to elapse after the larva had pierced the skin to allow for the removal of the major portion of this dye by the rubbing of the appendages over the pulp of the fruit within the cavity, it is believed that practically the whole of the rather plentiful supply of dye was actually within the mouth cavity.

Examination of the body contents of larvae 24 hours or more after they had entered showed in most cases a varying quantity of carmine dye, usually pretty well toward the posterior end. None was demonstrable at this time in the oral cavity, and none was noted in the foregut. These larvae were not sectioned but merely teased apart in water. The exact location of the dye could not be determined, but most of it was pressed from the body cavity by pressure on the cover glass, and was found near the posterior end of the body. The body contents as expressed by pressure or by teasing showed little that seemed to be fruit pulp. Even the contents of the foregut showed the presence of no typical plant cells, but merely a rather unorganized, faintly brownish, gruellike material, with no definite structure even under high magnification.

The quantity of carmine present in four successive larvae examined is rather typical of the whole series examined. The first showed carmine in considerable quantities, enough to show faintly rosy through the posterior body wall before teasing and crushing. The second showed only one small cluster of carmine dots in the body contents. The third showed no carmine whatsoever, while the fourth showed a number of small spots of carmine, possibly between one-third and one-half as much as the first examined.

Had the material been lead arsenate there is no question but that sufficient was present in the first and last to have caused death. The second was doubtful; probably a reasonably vigorous larva would have survived the quantity present, while a weaker larva might well have succumbed either within a short time or some days subsequently. The third would undoubtedly have survived.

It should be noted that three of the four showed the presence of foreign material, a fair sample of the series examined. Two contained an excess, the third sufficient to cause death probably in a considerable fraction of those carrying that dosage, had the material been arsenical. This corresponds fairly well with the expectancy as shown by Smith's work (1), and by unpublished data from this laboratory; that is, somewhere between one-fourth and one-third of the larvae successfully enter even fairly heavily sprayed fruit.

Since the general conditions were the same it is believed that the carmine-sprayed fruit represents fairly well the conditions in the case of orchard-sprayed fruit. If this be true, it is evident that most of the arsenic must be taken at the time of entrance, that probably the greater portion of the dose is due to arsenic taken into the mouth with the bits of skin, and with pulp subsequently smeared with poison before the worm has finally made complete entrance. That the number found containing foreign material corresponds fairly well with the usual field percentage of kill seems to substantiate this view.

Under field conditions, however, it is believed that some additional kill occasionally results either from spraying within 24 hours of entrance, or from heavy beating rains within that period. This additional kill is believed to be due to the soaking of the frass and to the ultimate poisoning of the pulp within by the spray or by arsenic-charged raindrops. Since the larva usually remains just under the skin for about 24 to 36 hours unless the temperatures be excessively high, the arsenical thus beaten into the fruit poisons the pulp and is ingested by the larva as it excavates the poisoned pulp. There would seem to be no other basis for accounting for the increased kill that occurs under field conditions immediately following spraying or heavy beating rains.

Summary

1. The question of the manner in which codling moth larvae ingest arsenic has been raised, owing to the fact that they reject the first bits of skin cut from the fruit.

2. The larvae have been shown to continue to reject the particles of fruit for a considerable time after they enter the fruit, larvae 24 to 48 hours later showing little sign of fruit pulp in the alimentary tract.

3. Such larvae give indications of ingesting 'juice', as the typical brownish tinge of oxidized fruit juice is noticeable despite the absence of form elements.

4. The larva picks up considerable foreign matter such as carmine upon the setae, legs, and other appendages, some of which is carried into the fruit at entrance.

5. Most of the arsenic is probably obtained by the taking into the buccal cavity of bits of skin and pulp cut from the fruit during the process of entering. These bits are afterwards expelled, but a considerable portion of the foreign material remains within the mouth cavity.

6. Carmine ingested in this manner may be demonstrated in varying quantities in approximately three-fourths of the larvae within 24 hours after entrance into the fruit. The quantity ingested is such as to suggest that between one-fourth and one-third of the larvae would survive were the material lead arsenate.

Literature Cited

(1) Smith, Ralph H. 1926. The Efficacy of Lead Arsenate in Controlling Codling Moth. Hilgardia, Vol. 1, No. 17.

THE BIOLOGY OF CAECIDOTEA TRIDENTATA HUNGERFORD (ISOPODA-CRUSTACEA)

CLARENCE H. HOFFMANN, Lawrence, Kansas *

It was in 1871 that Packard (11) described **Caecidotea stygia,** and since that time eight other species of the genus **Caecidotea** Pack. have been recorded. An examination of the literature concerning the biology of this genus shows that information on the subject is meager, however, and that this phase of study has been almost neglected. In 1903, Hay (8) recorded some illuminating notes on the habits of **C. richardsonae** Hay and **C. stygia** Pack. (7). In 1922, Hungerford (10) contributed some notes of interest concerning **C. tridentata** Hung., and in 1927, Ueno (20) mentioned the fact that one specimen of **C. akiyoshiensis** had 53 white spherical eggs in its brood pouch. Since the biology of the genus **Caecidotea** Pack. is apparently confined to the above notes, the writer is glad to present these data on the biology of **C. tridentata** Hung.

Habitat.

The specimens of **Caecidotea tridentata** Hung. used in this study were obtained from the same cistern in Lawrence, Kansas, which Hungerford (10) describes in his paper entitled, "A New Subterranean Isopod". The cistern, now old and badly cracked, seldom has much water in it except after a big rain. On December 25, the writer collected many fine specimens (mature and immature) out of the half foot of water then standing in the cistern. A large number of the isopods were crawling about the filter and along the outer edge of the cistern, within an inch or two of the surface. Some, however, resided on top of the two or three inches of black slime that covered the bottom of the cistern. Other collections were made in later months when the water was over four feet deep.

An insect net was used to collect the isopods, and after the water became turbid, it was necessary to use a strong flashlight in order to note the position of those missed. When the water was disturbed, many of the isopods sought refuge in the crevices of the wall of the

* Contribution from the Department of Entomology, University of Kansas.

cistern, while others settled to the bottom and partially buried themselves in the mud. In its normal habitat, as well as in the laboratory, **Caecidotea tridentata** Hung. is active and can crawl very rapidly, the smaller members of the species being much quicker in action than those which have attained maturity.

The abode of **Caecidotea tridentata** Hung. is not limited, however, to cisterns and wells. On May 2, the writer in company with Mr. J. G. Shaw, took two females from a small stream a few miles west of Lawrence, Kansas. They were found on the underside of a rock that Mr. Shaw had overturned in the mud, a few feet from the edge of the water. The stream mentioned is fed by a spring situated on an adjoining hill.

Method of Isolation.

The collected specimens were brought to the laboratory in cistern water, and either isolated in finger bowls or small stenders. Five or six isopods were isolated in each finger bowl, while only a single specimen was placed in each of the small stenders, which were an inch deep and two inches in diameter. The vessels were kept half full of cistern water, and a daily change of water was made for the well-being of the isopods. They were fed fruit fly larvae every other day. The old water and waste were easily removed with the aid of a veterinary syringe. The stenders were placed on a black table top—which aids materially in the search for molted skins—and were covered with a piece of cardboard to exclude light.

Brood Pouches and Fecundity.

Hungerford (10), in speaking of this species, states that "the females possess the flattened brood pouches or oostegites at the base of the first four pairs of legs. Our specimens were obtained in June, and some of the females bear these plates." The writer has collected a number of specimens every month since the 25th of December, 1930, and it wasn't until June 21, 1931, that females bearing pouches with young were found. I might add here that out of 192 specimens of **Caecidotea tridentata** Hung. collected and examined during this study, only 31 proved to be females.

The brood pouch is oblong-oval and is formed by the overlapping of the oostegites, which become thin and membranous at this time. The plates of the first pair of

legs are small in comparison to the plates of the other three pairs of legs, and are bilobed. They turn in and overlap at the medial ventral line, forming a rather tight enclosure at the caudal aspect of head. The center and the opposite end of the pouch are also well fitted together by overlapping plates, but the latter may spread apart enough to allow the escape of the young. The pouch is quite conspicuous on the underside of the isopod, and in some specimens it may be seen easily from the side.

The size of the brood pouches of **Caecidotea tridentata** Hung. and the number of young in each may be ascertained from the table appended. As the chart indicates, mortality in the females bearing pouches was surprisingly high. This may be accounted for, however, by the fact that in July the temperature in the cistern was 72 degrees F. while that of the laboratory was about 88 degrees F. Besides that, previous rearings showed that the majority of females died much sooner than the males, and that they could not be handled very much and still live.

Measurements in Millimeters of the Females of **Caecidotea tridentata** Hung. and Their Brood Pouches.

Exp. No.	Date Collected	Length of female without antennae and uropods.	Brood Pouch		No. of young	Died
			Length	Greatest width		
31-60	6/20/31	13.4	4.3	2.5	70	6/20/31
31-62	6/21/31	9.3	3.6	1.9	6	6/23/31
31-63	6/21/31	12.5	3.9	1.6	55	6/22/31
31-64	6/21/31	6.5	3.6	1.8	40	6/23/31
31-65	6/21/31	10.1	3.7	1.8	42	6/22/31
31-74	6/24/31	11.7	4.8	2.3	46	6/25/31
31-75	6/24/31	12.7	3.9	1.6	Pouch Empty	6/25/31
31-76	6/24/31	12.2	4.3	1.8	Pouch Empty	6/25/31
31-77	6/24/31	11.1	4.1	1.8	55*	6/25/31

* Eggs.

Description of the Immature Stages and Behavior of the Newly Hatched.

The eggs which were removed from the pouch of a female were granular and pure white in color. In shape, they varied from almost spherical to hexagonal. Because of the varied shape of the egg, it was somewhat difficult to take measurements. The greatest length of each egg was taken as one measurement, while the corresponding width served as the other. Consequently, the average length of ten eggs of this species was .476, and the average width .408. The pure white eggs are arranged in parallel rows running lengthwise in the pouch, and form a distinct contrast to the membranous case that surrounds them. The newly hatched, which are curled and much longer than wide, are also white. They bear two pairs of appendages. The second and larger pair of appendages are very curious processes as may be noted from Figure I.

When the brood pouch of female 31-60 was examined, the writer was surprised to find seventy small isopods in a teeming mass. They were actively crawling over each other until released from the pouch into the surrounding water. This female died before all of the young had escaped from the pouch, and the unfortunate ones soon ceased to be active and died. The young issuing from the brood pouch are white in color and not unlike mature forms except for their small size. The length of the body without the antennae and uropods measures 1.2 mm., while the width is .28 mm. A large number of the active young were isolated, but most of them died within a few days. The extreme hot weather was probably the causal factor in the mortality.

Molting.

Sixty specimens of **Caecidotea tridentata** Hung. were isolated in stenders, fed, and watched for several months. Of this number, 17 molted two or more times. It is very interesting to watch them molt, but, of course, one seldom sees the entire process under the binocular because of the restlessness of the isopods. The skin is shed in two separate parts, the anterior portion consisting of the antennae, head, and the first four thoracic segments, and the posterior part consisting of the remaining thoracic segments, the abdomen, and the uropods. Usually the posterior portion is shed several hours before the anterior part, although in one or two cases the reverse was true. After one half of the skin has been molted, the new part forms a striking contrast to the old dirty skin that has not yet been sloughed off.

In molting the posterior part first, the skin splits where the fourth and fifth thoracic segments join together, and the isopod crawls around rapidly, twisting the posterior part of the body first one way and then the other, in a figure S shape. Sometimes the ventral part of the caudal end of the body is turned over completely in effort to get rid of the old skin. The legs that are free aid a great deal in molting, and the last abdominal segment is often humped during the process. Some specimens molted this portion in fifteen minutes, while it took others several hours to complete the process. The anterior molt is accomplished by a series of rapid twistings of the fore part of the body, the sides of the thoracic segments often attaining a vertical position, and the ventral part of the head becoming somewhat upright. The rapidity with which the isopod turns its body is astonishing, and within five minutes it may back out from beneath this part of the old skin.

Longevity.

The isolated rearings tend to indicate that it would take this species of isopod a long time to grow from the time it left the brood pouch to maturity. The body of female 30-44 without the antennae and uropods measured 5.8 mm. long when taken on February 6, 1931. Although this specimen molted 6 times, it was only 7 mm. long at the time of death, June 2, 1931. Another specimen collected on the same date and which was small enough to crawl through the fine meshes of an insect

net with ease, molted 7 times and was only 6.6 mm. long at the time of its death on June 30, 1931. Considering the fact that the young are slightly over a millimeter long when they leave the brood pouch, it would be hard to conjecture the number of times **Caecidotea tridentata** Hung. molts before becoming mature. Many specimens lived four and five months in the laboratory, but none molted as many times as the two specimens already mentioned.

Food Habits

Caecidotea tridentata Hung. lives upon organisms found in the water and upon larger insects and Crustacea that fall and die in the water. Some remained alive in the laboratory for a month with just a daily change of cistern water. The torn carcasses of terrestrial isopods found strewn about in the water of the cistern would indicate that they had served as food for their aquatic relatives. In the laboratory, **C. tridentata** fed upon dead aquatic isopods, scuds, fruit fly larvae, fairy shrimps, dragon fly naiads, damsel fly naiads, and unfortunate individuals of their own kind. This species of isopod also attacked and fed upon injured damsel fly naiads and on living fruit fly larvae. **Caecidotea tridentata** Hung. evidently does not require much food, because most of the specimens consumed only two or three fruit fly larvae a week.

Behavior

The isopods collected December 25, 1930, were first isolated in finger bowls, each containing 5 or 6 specimens. Within a few minutes, the isopods in each bowl had come together and formed an almost perfect ball. If they were pulled apart, it was a matter of only a few minutes until they were massed together again. This procedure lasted for several days, after which they began to feed upon the weak or disabled individuals. Since they proved to be cannibalistic, a single specimen was placed in a stender dish containing cistern water. The dishes were not covered the first night, however, and the writer lost many good specimens that had crawled out of the dishes, and which had dried up and died.

The specimens of **Caecidotea tridentata** Hung. kept in the laboratory spent most of their time crawling about the stenders, feeding occasionally, and cleaning the posterior legs by means of the propodi of the first pair

of legs. Those kept in the aquarium where the light was not excluded would hide under the debris in the bottom. One of the specimens was noted to have lost one of its uropods, so it was watched to see if another one would be regenerated. A small uropod visible to the naked eye appeared within two weeks time. If disturbed this species either crawls away rapidly or feigns death. In the case of molting, however, the isopods usually turn over on their sides and remain motionless for some time before crawling ahead again. Curiously enough, when females bearing full brood pouches are molested, they turn up the tip of the abdomen in an amusing but threatening manner.

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A NEW PENTHIMIA (HOMOPTERA, CICADELLIDAE)

PAUL B. LAWSON, Lawrence, Kansas*

For some time it has been thought that the genus Penthimia was represented in the United States by a single species, **P. americana.**

While recently examining specimens of this genus from Wisconsin, Michigan, Kansas, Texas, Louisiana, Georgia and Florida, the writer found agreement in the specimens from the first six states but noted that specimens from Florida differed in several respects from the others. Thinking at once that perhaps the Florida specimens represented Walker's **P. vicaria** which was described from that state, a pair of them and also a pair from Kansas, were sent Mr. W. E. China for comparison with Walker's type. Much to our surprise Mr. China replied that the Kansas specimens agreed with Walker's **vicaria** and that the Florida specimens did not. Accordingly the synonomy of **P. vicaria** with **P. americana** is confirmed and a new species is described as follows:

Penthimia floridana sp. n.

Close to **P. americana** but with a longer and more rounded vertex. Length 4.5 to 5 mm.

Vertex nearly three-fourths as long as wide, rounded apically; ocelli quite small. Pronotum a little longer than vertex.

Genitalia: Female last ventral segment three times as long as preceding, posterior margin strongly sinuate and with a truncate median process. Male valve obtusely angulate apically; plates broadly triangular, exposing pygofer laterally, their apices reaching tip of pygofer.

Color: Very similar to **americana.** Varying from chestnut brown to nearly black, elytra usually flecked with small pale brown spots and apical cells inclined to be hyaline with few dark spots.

Holotype, male, Waldo, Fla., Aug. 18, 1930, R. H. Beamer. **Allotype,** female, same data. **Paratypes,** male, Sebring, Fla., Aug. 5, 1930, J. Nottingham; 3 males, Hilliard, Fla., Aug. 19, 1930, L. D. Tuthill; 1 male, Hilliard, Fla., Aug. 19, 1930, R. H. Beamer; 1 male and 2 females, Hilliard, Fla., Aug. 31, 1930, R. H. Beamer.

* Contribution from Department of Entomology, University of Kansas.

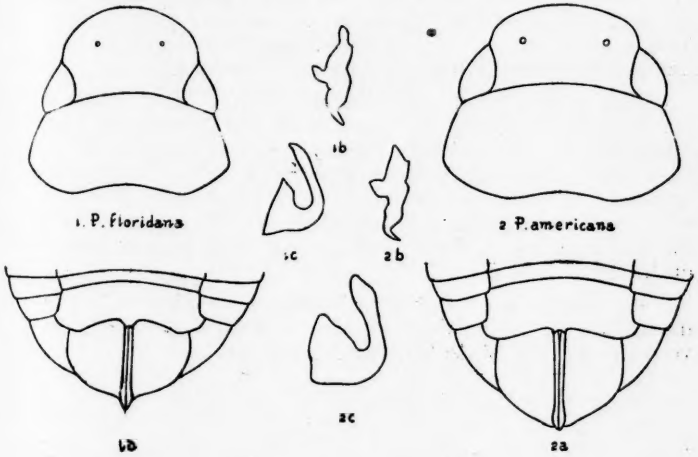
Types deposited in Snow Entomological Collection.

P. floridana differs from **P. americana** in the following ways as shown by the drawings: (1) The vertex is distinctly longer and more rounded. (2) The head and pronotum are distinctly narrower, as is the entire insect. (3) The ocelli are smaller. (4) The female last ventral segment is more sinuate and the median process more produced though not as distinctly toothed. (5) The pygofer is shorter. (6) The oedagus is smaller and not expanded pre-apically. (7) The apical tooth of the style is distinctly stouter.

In the drawings of the heads the specimens were tilted so as to show the greatest length of vertex.

Explanation of Drawings.

1. **P. floridana,** head and pronotum.
1a. **P. floridana,** female genitalia.
1b. **P. floridana,** style.
1c. **P. floridana,** oedagus.
2. **P. americana,** head and pronotum.
2a. **P. americana,** female genitalia.
2b. **P. americana,** style.
2c. **P. americana,** oedagus.



NOTES

The interesting Coccid, **Orthezia solidaginis** Sanders, was found on July 6, 1932, in very large numbers, literally covering a considerable area of plants on the banks of the Kansas River at Lawrence, Kansas. In 1917 the writer found it on **Ambrosia trifida.** This time it occurred on the Composits, **Solidago serotina, Helianthus tuberosus, Erigeron canadensis,** and on the Labiate, **Teucrium canadense.** Both adults and nymphs were found on all four species of plants.

Paul B. Lawson.

On April 2, 1932, three males and two females of **Schistocerca damnifica** (Sauss.) were collected near the Leavenworth County State Lake. Heretofore this species has been taken only in the extreme southeastern edge of Kansas. This species is typically southern and according to Hebard's Orthoptera of Kansas, (Proc. Acad. Nat. Sci. Pa., lxxxiii, 1931, 1. 119-227) this find extends its northern limits about 150 miles.

R. H. Beamer.

Dr. R. H. Painter, Associate Professor of Entomology, Kansas State College, has received a grant of $300.00 from the Bache Fund of the National Academy of Sciences to be used for taxonomic studies of the Bombyliidae in the Museum of Comparative Zoology, Cambridge; American Museum of Natural History, New York; Academy of Natural Sciences, Philadelphia, and the United States National Museum Washington, D. C.

This is the third recognition which Doctor Painter has received recently for his taxonomic studies of the Bombyliidae. The others were an award of $125.00 from the Permanent Science Fund of the American Academy of Arts and Sciences, and a request from the Editor of the Lingnan Science Journal to classify the Bombyliidae of China, which monograph has been published.

Doctor Painter left Manhattan December 4th for his studies in the eastern museums, and will be absent from the Kansas State College for six weeks.

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